TECHNICAL SPECIFICATION

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Function blocks (FB) for process control –

Part 1:
Overview of system aspects

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FUNCTION BLOCKS (FB) FOR PROCESS CONTROL –

Part 1: Overview of system aspects

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards. IEC 61804-1, which is a Technical Specification, has been prepared by subcommittee 65C: Digital communications, of IEC technical committee 65: Industrial-process measurement and control.

This standard cancels and replaces IEC/PAS 61804-1 published in 2002.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
65C/296/DTS	65C/310A/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61804 consists of the following parts under the general title *Function blocks (FB) for process control*

Part 1: *Overview of system aspects*

Part 2: *Specification of FB concept and electronic device description language (EDDL)*

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

- transformed into an International standard;
- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

This Technical Specification is an end-user driven specification of the requirements of distributed process control systems based on Function Blocks (FB). This Technical Specification and its associated FB standard (IEC 61804-2) originate from the power-plant industrial sector. It is validated by applications in oil and gas, petrochemicals, pharmaceuticals and fine chemicals, pulp and paper, food and beverage, waste water treatment plants, steel milling and others. There will be other general requirement standards and associated specifications for other industrial sectors.

Present and future digital process control systems need to fulfil the following requirements:

- increase security and safety;
- reduce time to market;
- be supportable with available tools;
- reduce costs of development and support;
- minimize training costs;
- support integration of distributed control applications
- support integrated methodology for implementation;
- have increased maintainability, modifiability, agility, upgradeability, flexibility, ability to validate, accessibility, availability, compatibility of support tools, multi-vendor device/ application compatibility, re-usability of knowledge and designs, re-usability of software components;
- be made up of digital devices that are compatible, interworkable, interconnectable interoperable and interchangeable with each other.

Process control systems are required to fulfil these requirements in terms of their architecture and their operation during all the phases of the life cycle. The accepted basic concept for the design process control system is to describe all necessary implementation-specific functions with FB. A FB is an encapsulation of data and algorithms to provide a specific function, which can be self-standing. Process control systems can involve many instances of many different FBs operating in an environment providing common services (for example, communications) and interfaces to other applications. See Figure 1.

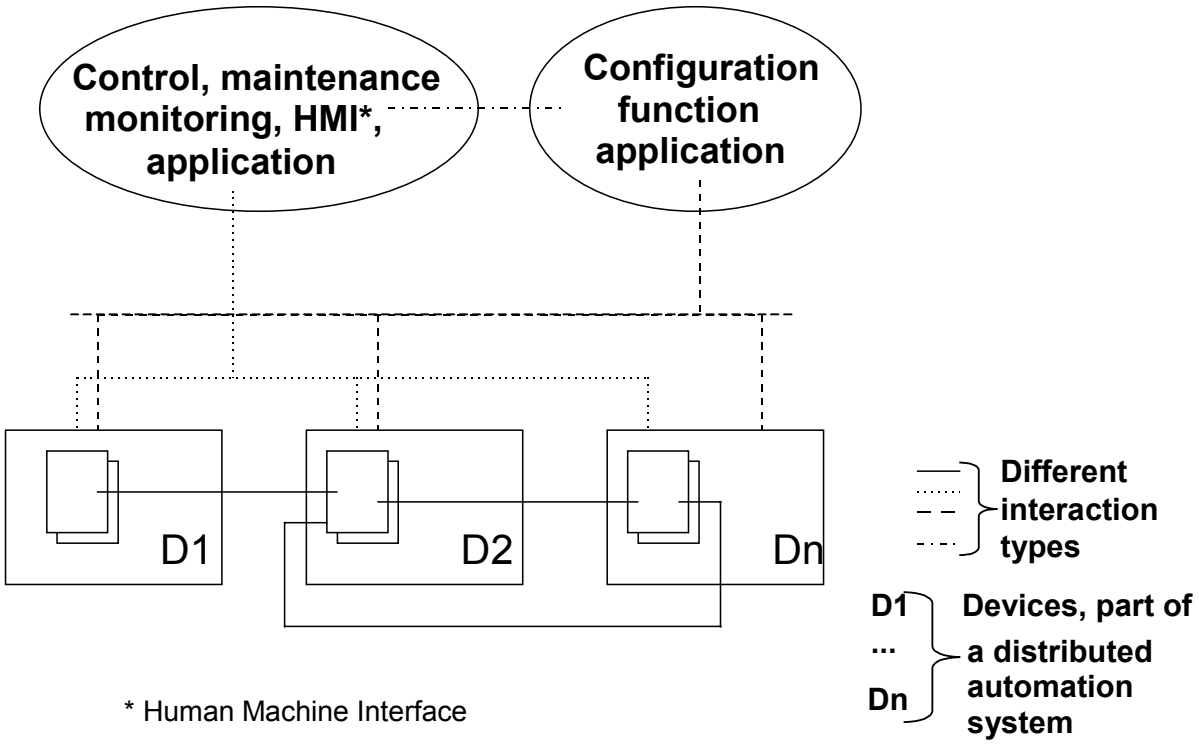


Figure 1 – Interactions of applications

FUNCTION BLOCKS (FB) FOR PROCESS CONTROL –

Part 1: Overview of system aspects

1 Scope

This part of IEC 61804 is a Technical Specification which provides *guidelines* for suppliers to meet evolving requirements for digital process control systems through which users can be assured of the compatibility, the interworkability, the interconnectability, the interoperability and the interchangeability of the devices they choose. This part gives the overall requirements. For better understanding, this part gives background information and examples in annexes.

This Technical Specification defines the requirements for FBs to provide control and to facilitate maintenance and technical management as applications which interact with actuators and measurement devices:

- control covers functions necessary to bring and hold the process at the desired behaviour;
- maintenance covers functions to acquire information about the state of the process equipment and the state of automation devices including their adjustments, for example, calibrate a sensor that has drifted;
- technical management deals with information for the optimization of the process.

  It is concerned primarily with the economics of the process and plant equipment. This relates in particular to the evaluation of performance and reliability of specific items of plant or equipment for all the installed period and comparison of performance and reliability of items from different suppliers performing an identical function in the same operating environment. An example of performance is the number of cycles achieved before failure of two valves from different suppliers. This allows for the production of detailed and valid statistical analysis to support management decisions and plant equipment modifications.

A prerequisite for designing, implementing and operating a FB-based process control system is that the tools, the devices and other components follow the same architecture based on a common specification. The architecture is required to define the components of the systems, for example FB, device, data, data connections and more as well as relations between these components. The IEC 61499 series generic FB model on which this Technical Specification is related is able to provide these basic components for FBs for process control. One add-on to the IEC 61499 series is the specification of parameters and functions of FBs that are implementable in devices.

The architecture and the range of FBs that have to be specified are described in 7.4 contains a minimum set of FBs that will be required for the process industries. These are presented in TWO different clauses. One deals with “rich” FBs covering complex but common functions such as control loop (for example proportional, integral, differential – PID) required by the majority of the process industries. Another covers a set of elementary FBs (EFB) such as Boolean functions required to compose very specific and unique functionality.

FBs are used during the complete life cycle of process control systems but viewed from different aspects. This is covered in detail in Annex A. The process design starts with the Piping and Instrumentation Diagram (P&ID) which gives the requirements of the process and instrumentation from a purely functional point of view. From the P&ID, the desired behaviour of the process control system is extracted into a functional requirements diagram (FRD) without considering the detailed behaviour of the underlying devices. The bricks making up the FRD are application blocks (AB), the representation of the data and algorithms in the

design phase. After discussion between the process and automation engineers (end-user and system integrator), the FRDs are turned into detailed designs for the application via several design using devices available on the market together with interconnections and configurations of these devices. In this way a PID loop shown in via bubbles on a P&ID will be transformed into implementable FBs in specific field and/or control-room devices. It should be noted that many parts of the process industries, in particular those with many similar and relatively simple processes (for example, the water industry), do not use the concept or term FRD. They go directly from P&IDs to the implementable FBs and will use a variety of names to describe the process and the resulting design documents. The FRD approach is used here since it represents the most formal view of the design cycle and illustrates the use of FBs at the earliest of phases in the life cycle. Clause 4 summarizes the requirements from this life-cycle point of view.

This Technical Specification specifies a system (an industrial-process measurement and control system based on distributed FB application). A system is described stepwise in terms of architecture, models and the life cycle. The architecture is the "road map" which names the components and presents the structure of the system. The models describe the details of the components, i.e. their functions in the system. The life cycle makes visible how the components work together during their use in different phases of the lifetime, i.e. it makes the operation visible.

Figure 2 shows the different influences, basic specifications and technology support on IEC 61804 from the top-down and bottom-up point of view.

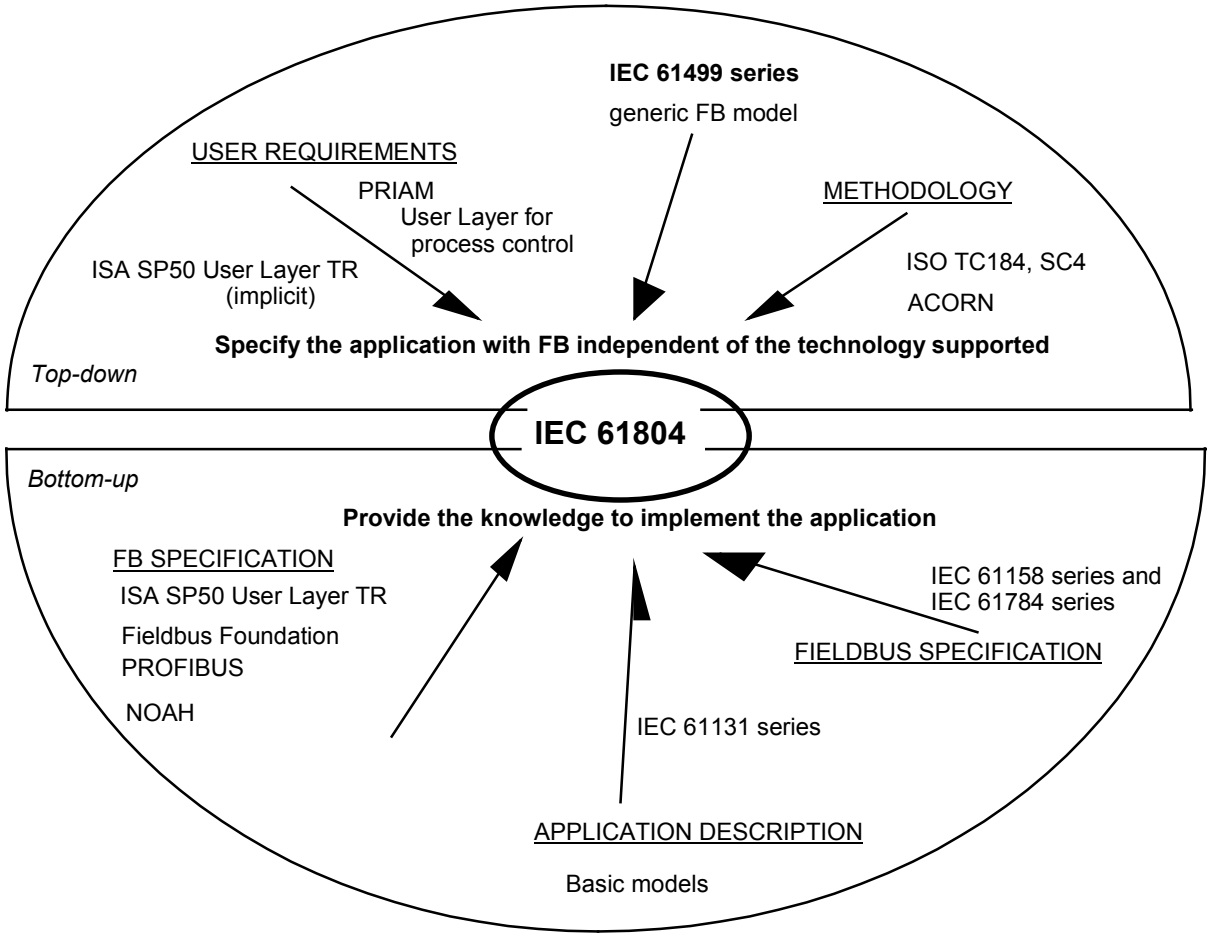


Figure 2 – Influences on IEC 61804

The influences are international standards and projects (PROFIBUS and Fieldbus Foundation[1]), which relate to the same area as IEC 61804. These standards are either technology-independent ones supporting the top-down approach or dedicated to a certain technology, for example, programmable controller or fieldbus. Both together will build the basis of the standard specified by IEC 61804.

The main purpose of this part is the harmonization of different views, models and starting points of end-users, system providers and device manufacturers. It will be the reference document leading the discussions during the specification and the guideline for the readers of IEC 61804-2.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61131-3:1992, *Programmable controllers – Part 3: Programming languages*

IEC 61499-1:2000, *Function blocks for industrial-process measurement and control systems – Part 1: Architecture*

IEC 61512-1:1997, *Batch control – Part 1:Models and terminology*

IEC 61784:2003, *Digital data communications for measurement and control – Part 1: Profile sets for continuous and discrete manufacturing – Fieldbus relative to use in industrial control systems*

IEC 61158 (all parts), *Digital data communication for measurement and control – Fieldbus for use in industrial control systems*

IEC 61804-2, *Function blocks for process control – Part 2: Specification of FB concept and Electronic Device Description Language (EDDL)* [2]

EN 50170:1996, *General purpose field communication system*

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[2] To be published.